Patent Application: US 2007/0056462 A1 Not Patentable
Objections to Its Further Amended Claims

Observations Prepared for USPTO
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Biblio. Data of the Application in Question

(10) Pub. No.: US 2007/0056462 A1
(43) Pub. Date: Mar. 15, 2007
(54) OIL WELL PERFORATORS
(21) Appl. No. 10/574,999
(22) PCT Filed: Oct. 8, 2004
(30) Foreign Application Priority Data
Oct. 10, 2003 (GB).....0323717.9 (not valid, abandoned before publication)
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It has been noticed that the applicant has again amended its claims after the non-final rejection (under RCE). After reviewing the amendment, it is found there is still nothing new that deserves patent protection.

Overall Opinion on the Patentability

It has been known in the industry that there is a "dual explosion" shaped charge disclosed by US patent 7,393,423 (Liu). The new concept charge creates two explosions, the first being the detonation of high explosives which generates a high-speed jet to penetrate a target and project molten aluminum into the target and then the second explosion occurs within the target which is molten aluminum/water reaction. Further, another patent USP 5,212,343 (Brupbacher et al) teaches the use of intermetallics (including NiAl) to react with water and create an explosion event. Given the teachings of the mentioned two patents, it is more than obvious to make a "dual explosion" shaped charge using intermetallic reactions including the use of Al/Ni, Al/Pd combinations.

Consequently, the application in question is an obviously anticipated variation to the "dual explosion" shaped charge disclosed by USP 7,393,423 (Liu) and it is not patentable. The application in question and its associated shaped charge do not depart from the spirit of the Liu patent.

A basic fact is that the shaped charge associated with the application in question has to be used in water to create a molten aluminum/water explosion in target, or in its variation form of molten aluminum alloyed with another metal to react with water. Otherwise, its shaped charge is basically useless or even detrimental to the hydrocarbon bearing formation. This is due to the fact that intermetallics are generally extremely hard in physical properties and hardly soluble by acid in its chemical properties, so once deposited into a formation, it can cause problems to hydrocarbon

production. However, the application in question seems to be evasive in talking about the in-target Al/water reaction (which will consume molten aluminum or its alloy) by not mentioning it at all. A shaped charge made according to this application is to infringe the patent rights of the issued Liu patent.

Instead, in trying to get a patent, the application emphasizes the use of exothermic intermetallic reaction between two metals. However, this is not new at all to the shaped charge community. As presented in an early correspondence, as early as 1996, a report released by Sandia National Laboratories (SAND-95-2448C, Fisher & Grubelich, 1996) clearly teaches the use of intermetallic materials including the combinations of Al/Ni and Al/Pd as shaped charge liner material, by compacting metal powders (or say in their particulate form, by the applicant's wording). The applicant seems to be using terminology that is not commonly used in the industry and by colleagues.

After a number of rejections, now the newly amended claims are seeking patent protection for an intermetallic combination plus a "further metal".

Is this really new and deserve patent protection?

Observation #1
It is only a known art and engineering routine.

In shaped charge design and manufacturing using powdered metal liners, it is a known art to change the ratio between powder metal compositions to achieve a liner density required. There is in fact no difference to the powder metallurgy industry in the art of mixing metal powders.

When two compositions having the tendency to react with each other under proper conditions (in powder metal part sintering, or shock wave activation), there is no change in the art of mixing and preparing the powder to achieve required density. In other words, to prepare a powder metal liner mixture containing compositions for intermetallic reaction is no different from that for regular powder metal liners.

You do not need an invention to add a third component.

This is well known and widely practiced in the industry.
As a proof, please read an excerpt below from Liu's patent. It should be emphasized that this citation is not an inventive disclosure, but just a description of such practice.

An excerpt from US Patent 7,393,423 (Liu) (Col. 24, lines 42-60), describing the practice of adjusting liner compositions to achieve required density for powder metal liners:

However, with the shaped charge of the present invention, if a deeper penetration is required than that would be achieved with pure aluminum liner, a mixture of aluminum powder with other high density metal powders such as iron, tin, copper, lead, tungsten, etc. can be used. When liner **10** shown in FIG. **6** is to be manufactured by compacting metal powder, the metal powder can be pure aluminum or a mixture with another metal powder such as copper powder. The density of the liner can be adjusted by changing the ratio of aluminum in the mixture. Take the mixture of aluminum-copper powder as an example, any liner density from that of compacted aluminum powder to that of compacted copper powder is achievable by changing the ratio of the mixture from pure aluminum to pure copper powder. Then the right liner density for the required charge performance can be found. For example, a mixture of 50% aluminum powder with 50% copper powder used to make a liner would have a density more than two times higher than that made with pure aluminum powder. This would significantly increase the charge penetration, but the

In the art of perforator (shaped charge) design, it is widely known that the use of high density materials such as tungsten will help to increase penetration into target. For powdered metal liners, the usage of compositions having high density such as tungsten powder is controlled to achieve designed liner density and product economy.

In the applicant's reply (In the first page of "REMARKS" after the amended claims, 2nd paragraph from bottom), it is said that *"a further metal is to provide additional mechanical strength to the liner ..."*, this seems to be in error. People in the art know that it is the increase in liner density, but not the strength that will help to increase penetrative power.

Therefore, the application in question still lacks the novelty, creativity and necessary inventive steps for patent protection.

Observation #2

Intermetallic reaction does not only happen between Aluminum/Nickel or Aluminum/Palladium, it can also happen with the "further metal" such as Copper and Tungsten.

The amended claims 1, 2, 3 and 20 seem to define a scope of claim to a mixture of liner material composed of intermetallic compositions such as Al/Ni or Al/Pd with the addition of a "further metal" such as Cu and W.

It is assumed that the exothermic intermetallic alloying reaction only happens between Al/Ni or Al/Pd, and the "further" metal is regarded as "*inert*" and "*is not capable of an exothermic reaction with the at least two metals upon activation of the shaped charge liner*".

However, it should be pointed out that such a statement is only the applicant's wishful assumption, but not a scientific fact.

Here the applicant should be reminded that, in the excerpt of the Liu patent shown above, when a mixture of Al/Cu is used as liner material, there is intermetallic reaction between them upon actuation. According to the mentioned Sandia report, when the mole ratio between the two compositions is 1:1, the theoretical maximum density of pressed powder will be ρ_{TMD}= 5.294 grams/cm^3, its adiabatic reaction temperature is 935°K and its heat of reaction is as high as 108 cal/gram. Additionally, other metal powders, such as lead or tungsten powder, can be added to the Al/Cu mixture to achieve liner density requirements.

Now the question to the applicant is that in a liner mixture containing Al, Ni, Cu and W, upon actuation by shock wave, how can one guarantee that the intermetallic reaction will only happen between Al and Ni? And that the "further metal", here Cu or W, will behave chemically inert and there will be no copper aluminide (CuAl) or tungsten aluminide (WAl_2) formed?

Consequently, the scientific ground of the amended claims is questionable.

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